CLEANING DEVICE FOR FIBER OPTIC CONNECTORS

Cross-Reference To Related Application

This application claims priority to U.S. Provisional Patent Application No. 60/424,534 filed November 7, 2002.

Technical Field

The present invention relates to a cleaning device useful for cleaning the optical fibers in a connector. In particular, the present invention relates to a hand-held device suitable for cleaning the optical fibers that have been mounted in a ferrule.

Background

Optical fibers have become useful for transmitting information such as data and voice communication. For similar sized cables, the advantage of optical fiber cables over traditional wire cables lies in the fibers' improved transmission rate and in the increased capacity to transmit information.

Optical fibers are often terminated and coupled to other optical fibers or to other terminals through the use of connectors. In some optical connectors, ferrules are used. The ferrule typically has a plurality of fiber receiving channels where the optical fibers are mounted. When two connectors are used to connect two optical cables, a first connector typically contains a ferrule that has at least one guide pin extending from its end face. A second connector contains a mating ferrule that has at least one guide pin hole on its end face. In this particular design, alignment and mating of the two connectors occurs when the guide pin is inserted in the guide pin hole. The optical fibers in mating connectors should have intimate contact in order to minimize light transmission loss between them. Thus, it is desirable that the mating end faces of the ferrules be free of lint, dirt, oil, and other debris. It is known in the art to clean the ferrule end faces to minimize light transmission loss by minimizing the dirt.

For example US Patent No. 6,449,795 B1 (Sato) discloses a cleaning tool for optical fiber connectors comprising a bar form stem, a support, the outside of which is covered with a cleaning cloth made of ultra fine filament bundle having a filament fiber size of 0.1 denier or less. The stem and the support are made integrally from resin.

US Patent No. 6,415,471 B1 (Childers et al.) discloses another device for cleaning the polished end faces of fibers in an optical connector having guide pins. The device has a surface with at least one rail disposed on the surface. The rail has a height above the surface sufficient to accommodate guide pins extending from an optical connector. An overlay is disposed over the surface of the device and functions as the cleaning cloth.

US Patent No. 5,220,703 (Kanayama et al.) discloses yet another optical connector cleaner. The cleaner comprises (i) a cleaning cloth woven with ultrafine fiber less than 0.1 denier, (ii) a casing formed with at least one opening for protecting the cleaning cloth from dust, and (iii) a mechanism for shifting the cleaning cloth exposed in the opening for renewing the cloth after ferrule end surface has been cleaned.

Although the foregoing references may provide useful connector cleaning devices, there is a need for other easy to use devices.

Summary

The present invention provides a unique device useful for cleaning fiber optic connectors. Although the device is particularly suited to clean the polished end faces of a ferrule that has optical fibers mounted therein and to clean the mating surfaces of connectors, it can also be used to clean other surfaces of the connector. The device is designed to easily accommodate the polished end faces of a ferrule that contains no guide pins or at least one guide pin.

In brief summary, the present invention pertains to a device for cleaning a polished end-face of an optical connector, the device comprising (a) a three-dimensional base having at least three sides, the base having a polygonal cross-section (b) a cleaning media disposed on at least a portion of at least one side of the base; and (c) means for fastening the cleaning media to the base.

Brief Description of the Drawings

The invention is further described with reference to the following drawings, wherein:

Figure 1 is a cross-sectional view of one embodiment in accordance with the present invention;

Figure 2 is a cross-sectional view of another embodiment in accordance with the present invention;

Figures 3a and 3b are isometric views of another embodiment in accordance with the present invention in the unfastened and fastened conditions respectively;

Figures 4a and 4b are, respectively, side view and isometric view of a means for fastening that can be used in accordance with the present invention;

Figure 5 is a isometric view of another embodiment in accordance with the present invention using the means for fastening shown in Figures 4a and 4b; and

Figure 6 is an isometric view of a connector.

These figures are idealized, not drawn to scale, and are intended to be illustrative and non-limiting.

Detailed Description

Figure **1** is a cross-sectional view of one embodiment of the present invention wherein device **1** has a cleaning media **12** disposed on at least a portion of three-dimensional base **10**. In this particular embodiment, in cross-section view, the base is a truncated triangle having a substantially flat peak **10a** and sides **10b**, **10c** and **10d** and means for fastening cleaning media **12** to polygonal base **10** is the roughened surface (not shown) of sides **10b** and **10c**. Sand blasting the surfaces is one way to roughen them. At least one of the angles, indicated as angle α, is truncated. When the truncated angle α is projected out, as shown by the dashed line, the included angle measures less than about 30°. Although cleaning media **12** is shown to be disposed on sides **10b** and **10c**, it is within the scope of the present invention to have it wrap around all sides of the base. And, it is within the scope of the present invention to have a base whose cross-section has no truncated angles, i.e., side **10a** would be a true peak. Thus, the base has a minimum of

three sides. In use, an operator can clean the polished end surface of the connector using the cleaning media at the general area designated at peak **10a**. The operator can advance new cleaning media to the peak **10a** by removing it from the base and repositioning it on to the base.

Figure **2** is a cross-sectional view of another embodiment of the present invention wherein device **2** uses means for fastening **14** to fasten cleaning media **12** to at least a portion of base **10**. In this particular embodiment, the means for fastening is a tape, e.g., a microreplicated tape having an adhesive backing that can be laminated to sides **10b** and **10c.** The microreplicated tape has protrusions extending outwardly from the backing to grab cleaning media **12** so as to secure it. The tape allows for repositioning of the cleaning media so that new cleaning media could be advanced to the peak area once it has been used.

Figures **3a** and **3b** illustrate yet another embodiment of the present invention in the unfastened and fastened conditions respectively. In this particular embodiment, the means for fastening cleaning media **12** to polygonal base **10** is frame **16** having an opening **16a**. In use, frame **16** is disposed near the peak area of base **10** holding the cleaning media to the base while opening **16a** exposes a portion of the cleaning media for cleaning the optical connector. If desired, means for fastening **14** (shown in Figure **2**) or roughened sides **10b** and **10c** can also be used in conjunction with frame **16**.

Figures **4a** and **4b** show yet another means for fastening the cleaning media to the polygonal base. Means for fastening **18** is a cover with opening **18a** and optional finger tab **18b**. In this embodiment, means for fastening **18** is substantially triangular in cross-section, similar in shape to the cross-section of base **10**. Figure **5** shows yet another device **5** having cleaning media **12** sandwiched between means for fastening **18** and base **10** with opening **18a** disposed near the peak of the base thereby exposing a portion of the cleaning media for cleaning the optical connector. Hemispherical finger tab **18b** allows for easy removal of means for fastening **18**, as a user can push upwards on the tab and remove it. One skilled in the art will recognize that a hemispherical finger tab is one of many possible designs that can be used. The means for fastening **18** has a portion **18c** that function to protect at least a portion of the underlying cleaning media from contamination of dirt. In

use, while the device **5** is held in the operator's hands, it is the portion **18c** that is in contact with the hands. Any oil from the operator's skin, one of the more common sources of contamination, will not transfer to the cleaning media. Thus the cover provides advantages in that it protects the cleaning media, contains an opening for easy access to the cleaning media and simultaneously secures it to the base. While Figure **5** shows a means for fastening **18** that is in a form of an open cover, it is within the scope of the invention that the means for fastening is closed such that it slips over the polygonal base **10** and cleaning media **12**. For example, in Figure **5**, the means for fastening **18** can have up to three cut out portions **18a**, each disposed over one of the angles of the base. In this case, the finger tabs **18b** would most likely not be used.

Figure **6** shows a terminated connector **400** comprising a housing **410**, a polished ferrule **420** and guide pin holes **422**. The optical fibers **421** have been mounted in the ferrules. While not shown, in use, there would be a mating connector similar to that shown in Figure **6** except that where there are guide pin holes, there would be guide pins. When the connector **400** comes into contact with its mating connector, the guide pins reside in the guide pin holes. Prior to mating, it would be desirable to clean the end faces of the connector **400** as well as the mating connector. Because the mating connector contains guide pins, it can be difficult to clean in the area of the mounted optical fibers, i.e., the area between the guide pins. The present device allows for cleaning the polished end faces of the ferrules, whether they contain guide pins or not.

The three-dimensional base can be made of any material, so long as it does not introduce contaminants during use. Thus, materials that flake or chip easily are not suitable. The base should be sturdy, i.e., firm enough so that during use it will not move. Useful materials for the base include metals, polymers, ceramics, and wood. Suitable polymeric materials include those containing acetal homopolymers and copolymers (such as CELCON™ from Hoechst Celanese Co. and DELRIN™ from Du Pont Co.), nylon, polycarbonate, rigid polyvinyl chloride (PVC), and ABS (acetylene-butadiene-styrene). The base can be made by any number of methods depending on the material used. For example, when the base is polymeric, it can be injection molded.

As stated, in a cross-sectional view, the three-dimensional base is polygonal. The cross-sectional view can be taken either parallel or perpendicular to the bottom of the base, as represented, for example, by side **10d** in Figure **1**. Although a truncated triangle is one useful cross-section, one skilled in the art will recognize that a number of other polygons can be used as long as at least one of the angles is less than about 30°. For example, the base can have a star shaped cross-section in which case, all five angles can be used to clean the connector. There can be five separate means for fastening for each of the five angles or one continuous means for fastening, e.g., one continuous cover, to slip over the base. Wedges and rhomboids are other useful three-dimensional bases. The three dimensional base, however, does not contain a rail. If desired, the base can be modified to include cut outs or notches. For example, in Figure **3a,** in another embodiment, the base **10** contains cut outs on the peak area (i.e., near **10a,** not shown) front and rear portion thereof. This particular embodiment is useful in that it clearly delineates to a user where the cleaning media should be placed.

Referring to Figure **1**, one embodiment of a base has the following dimensions. The sides **10b** and **10c** are rectangular and have a length of about 3.5 inch (88.9 mm) with a width of about 1.0 to 1.25 inch (25.4 to 31.8 mm). The height of the base (i.e., the distance from side **10d** to peak **10a**) is about 2.0 inches (50.8 mm). The flat peak **10a** is about 0.035 to 0.045 inch (0.89 to 1.14 mm) with the angle α being about 30°.

In one embodiment, as described above in Figure **1**, the surfaces of at least one of the sides of the base can be modified, e.g., they can be roughened. When the base is a polymeric material, the sides can be surface roughened by sand blasting. In particular, when the base is CELCON™, one can roughen the side surfaces by bead blasting using a Dayton Co. from Dayton, OH model #3Z850 with a silicone carbide media at an air pressure of about 50 psi.

The cleaning media can be a swatch that covers a portion of the base or it can encircle the entire base. Suitable cleaning media includes products, such as (i) TexWipe® TX304, 100% cotton wipes, and Absorbond® TX404, hydroentangled polyester wipes from The TexWipe Co., Upper Saddle, NJ and at the website www.texwipe.com; (ii) the non-woven cloth from the Fiberclean dispenser System, Part

No. FOI, from the HellermannTyton, Milwaukee, WI and at the website www.hellermann.tyton.com; (iii) the micro fiber cleaning cloth from the OPTIPOP reel cleaner from NTT Advanced Technology Co. in Tokyo, Japan, and (iv) polyester wipes from the Tech Spray Co. in TX. Other types of polymeric cleaning media, such as nylon, polyethylene, and polypropylene can be used.

As disclosed in the various embodiments above, the means for fastening the cleaning media to the base can be selected from the group consisting of surface roughening the sides of the base, adhesives, frames, covers, and the like. Combinations of these means can be used. When the means for fastening are a frame or a cover, it can be made from a wide selection of materials, such as metals, polymers, and ceramics. Suitable polymers include polycarbonates, nylon, ABS, and rigid PVC. Each of the above recited means allow for repositioning of the cleaning media. If desired, the means for fastening can also be made static or electrostatic dissipative.